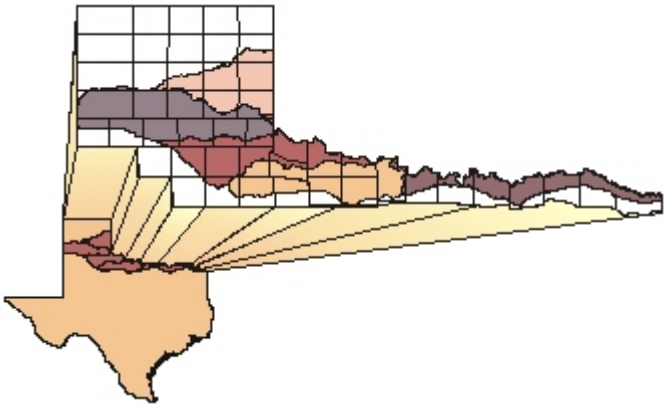


BASIN HIGHLIGHTS REPORT RED RIVER BASIN 2006

Since its inception in 1959, the mission of the Red River Authority of Texas has been to conserve, reclaim, protect, and develop water resources within the Red River Basin for the benefit of the public. In 1991 the Texas Legislature adopted Senate Bill 818, which addressed the newly adopted rules under Chapter 320 of the Texas Water Code. Thus, the Texas Clean Rivers Program (CRP) was created. The Authority played a key role in ensuring a solid foundation for the Clean Rivers Program and this charge has been enhanced through cooperative efforts with the Texas Commission on Environmental Quality (TCEQ), other state and federal agencies, local entities, and the public. Cooperative efforts of all entities involved have resulted in positive impacts on water quality, conservation, and the development of water resources within the basin.

OVERALL APPROACH TO WATER QUALITY

To assist in planning, monitoring, geographical analysis, and dissemination of data, the Authority divided the basin into five reaches. A five-year rotational approach was developed to adequately monitor the aquatic health of the basin. This rotational approach provides emphasis to be given to a different reach per year, ultimately intensively covering the entire basin over the five-year time span. A detailed discussion of the water quality in each reach is included later in this report.

WATER QUALITY ISSUES WITHIN THE RED RIVER BASIN

From a basinwide perspective the water quality in the Red River Basin is generally good and the vast majority of the basin supports aquatic life and recreational uses. Two major issues that affect the water quality is the continued *drought* conditions and excessive levels of *chloride*.

Drought

Drought is a recurring event in Texas. Since it is frequently widespread and can cover several regional climatic areas, the State may incur inconsistent levels of drought intensity from one region to another on a statewide basis. Although precipitation received in early 2005 provided some relief to parts of the Red River Basin, areas in north central and northeast of the basin are still experiencing drier than normal conditions. Response to these conditions has resulted in water conservation becoming a way of life for the citizens in the Red River Basin, as well as the rest of the state.

Without conservation practices being in place, parts of the state will virtually be "out of water" within 50 years. Regional water planning groups are continually working toward the development of plans to prepare for the continually changing water supplies and demands. Thus, water conservation has become the number one strategy in preserving this precious commodity. Recently submitted water plans have been posted on the Texas Water Development Board's website at www.twdb.state.tx.us/rwpg/main-docs/AdoptedRegionalPlan-index.asp.

Although water levels in some area reservoirs have increased due to the precipitation received in early 2005, others still remain uncomfortably lower than normal. **Table 1** shows the conservation capacity of the major reservoirs in the basin and their current capacity.

Table 1 – Major Reservoirs
Total Conservation Capacity versus Current Capacity Percentage

Reservoir	County	Basin Reach	Capacity Ac/Ft	Capacity Percentage	Reservoir	County	Basin Reach	Capacity Ac/Ft	Capacity Percentage
Pat Mayse	Lamar	I	124,500	75%	Kemp	Baylor	II	319,600	87%
Texoma	Grayson	I	2,722,300	88%	Greenbelt	Donley	V	58,200	37%
Arrowhead	Clay	II	262,100	86%	Mackenzie	Briscoe	IV	46,250	21%
Kickapoo	Archer	II	106,000	88%	** as of 12/2005 - Texas Water Development Board*				

Chloride

Historically, the Red River Basin was once part of an ancient inland sea. However, through geologic processes, this ancient sea became isolated and slowly evaporated over time. The salts from the prehistoric sea continue to plague the basin today. They occur naturally either through salt springs and seeps or from manmade events. As a result, the waters of the Red River, Wichita River, and Pease River systems contain excessive concentrations of chloride and sulfate.

In 1957, the federal government initiated a study which identified ten natural salt source areas located in the Red River Basin. These sources contribute a daily average of over 2,360 tons of the 3,540 tons per day of chloride that flow downstream and enter Lake Texoma in Grayson County. This equates to an amount greater than that consumed by every human and animal in the United States each year. The higher concentrated areas are located in Reaches II and III of the basin.

The Authority and the United States Army Corps of Engineers (USACE) have worked together since 1959 through the implementation of the Chloride Control Project to reclaim the water for beneficial uses for all living things. Since its beginning, this project has controlled more than 405 tons per day of chloride entering the river system without harming the environment. Three of the natural chloride sources are located in the Wichita River Basin (refer to **Figure 1**). To date, only one of the proposed chloride control facilities in the Wichita River Basin has been constructed and is operational. This low-flow dam structure on the South Wichita River retains low flows that are high in salts and diverts them via a pump station and pipeline to Truscott Brine Reservoir. Low-flow diversion dams were also planned several years ago for the Middle and North Wichita Rivers. If constructed, water high in chloride that would normally flow to Lakes Kemp and Diversion would be diverted to the Truscott Brine Reservoir. For additional information on the Chloride Control Project and/or the Wichita River Basin Chloride Control Project, please review the Authority's website at www.rra.dst.tx.us/ccp/ or the USACE's website at www.swt.usace.army.mil.

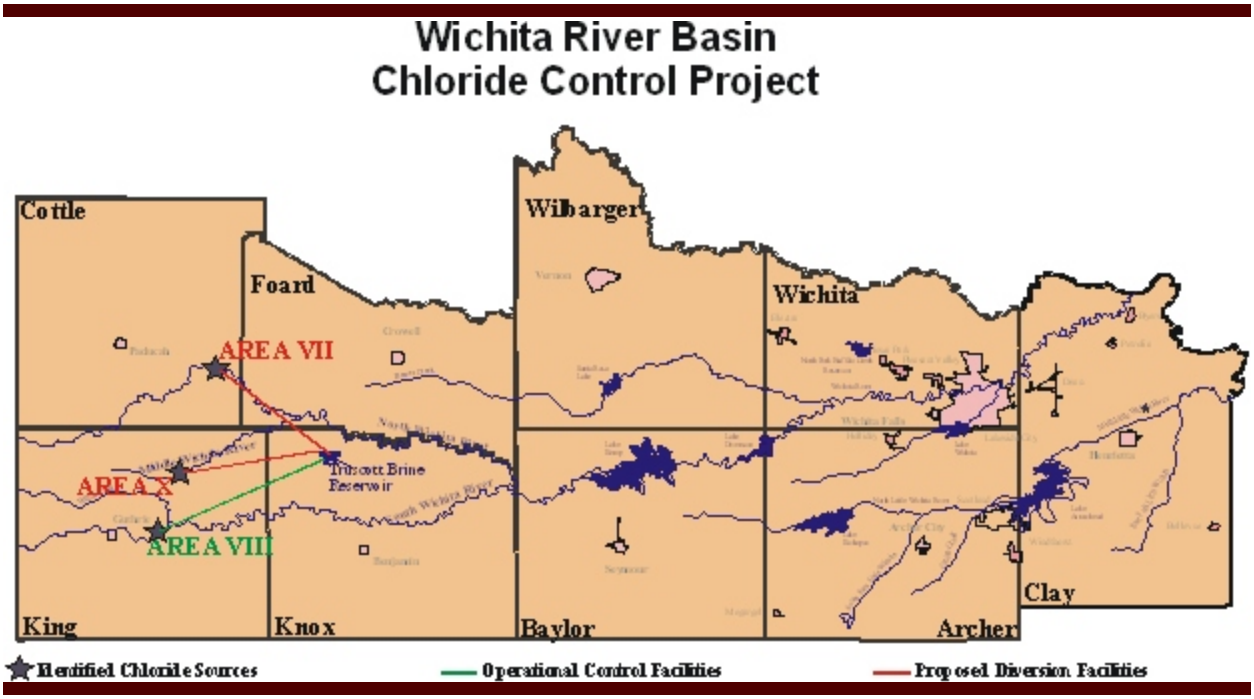


Figure 1

OVERVIEW OF WATER QUALITY MONITORING

The collection, management, and assessment of water quality data within the Red River Basin are integral components of the Clean Rivers Program. The Authority holds a Coordinated Monitoring Meeting annually to coordinate sites, parameters of concern, and frequency of collection with other agencies and program participants that assist in planning, data collection, and analysis. This meeting allows for the development of a monitoring schedule that reduces duplicative efforts, which in turn maximizes the funds available for sampling. It is an essential element in the successful planning process of the basin and is open to any interested group or entity that would like to attend and/or participate in monitoring in the Red River Basin. A summary of the monitoring schedule for the fiscal year 2005 is listed in **Table 2** or a more detailed Coordinated Monitoring Schedule for the Red River Basin can be found at http://cms.lcra.org.

Regular monitoring is necessary to collect quality-assured data to complete an assessment of water quality conditions and impairments. Assessing the data determines whether or not a waterbody meets its standards. There are four types of monitoring in the Red River Basin performed by the Authority, TCEQ, and USGS.

1. Fixed Station (Routine, Baseline) monitoring is conducted every year at key sites.

Regular monitoring is necessary to collect quality assured data.

2. Systematic Watershed (Intensive) monitoring is conducted at specific sites on the annual reach of focus.
3. Targeted monitoring identifies specific areas where additional information on water quality and quantity is needed for the permitting process.
4. Special Studies on priority watersheds are conducted where special attention is required.

Selected physical, chemical, and biological parameters collected by the Environmental Services Division (ESD) of the Authority are analyzed either in the field or at the Authority's environmental laboratory. Within days of collection, the results of the analyses are entered into the data repository, which contains years of quality-assured water resource information in the Red River Basin.

Table 2–Overview of Water Quality Monitoring - 2005

Agency	Reach	*Cont Flow	24-Hr DO	Metals Water	Organ Water	Metals Sed	Organ Sed	Conv	Ind Bact	Instant Flow	Field	RT	IS	DI	SS
RRA	I							48	70	46	70	12			2
TCEQ	I							30	48	17	30	10			
CRMWA	I														
USGS	I	365						4	4			1			
Total Reach I		**365**						**82**	**122**	**63**	**100**	**23**			**2**
RRA	II							16	16	16	16	4			
TCEQ	II		7	8		4		26	26	16	26	9		2	2
CRMWA	II														
USGS	II	5,110		96	16			96			2,555	14			
Total Reach II		**5,110**	**7**	**104**	**16**	**4**		**138**	**42**	**32**	**2,597**	**27**		**2**	**2**
RRA	III							8	19	19	19	2			1
TCEQ	III			2		2		20	20	20	20	5			1
CRMWA	III														
USGS	III	1,095		12	2			12			365	3			
Total Reach III		**1,095**		**14**	**2**	**2**		**40**	**39**	**39**	**404**	**10**			**2**
RRA	IV							12	12	12	12	3			
TCEQ	IV		4	4				12	12	8	12	4		1	
CRMWA	IV														
USGS	IV	1,460										4			
Total Reach IV		**1,460**	**4**	**4**				**24**	**24**	**20**	**24**	**11**		**1**	
RRA	V							12	12	12	12		3		
TCEQ	V							6	6	4	6	2			
CRMWA	V														
USGS	V	1,460						8	8		373	5			
Total Reach V		**1,460**						**26**	**26**	**16**	**391**	**7**	**3**		
Basin Total		**9,490**	**11**	**122**	**18**	**6**	**0**	**310**	**253**	**170**	**3,516**	**78**	**3**	**3**	**6**

Cont Flow . . . . . Continuous Flow
24-Hr DO . . 24-Hour Dissolved Oxygen
Metals Water . . . . . Metals in Water
Organ Water . . Organics in Water
Metals Sed . . Metals in Sediment
Conv . . Conventional Parameters
Ind Bact . . . . . Indicator Bacteria
Instant Flow Instantaneous Flow Measurements
Field . . . . . Field Parameters
RT . . . . . Routine Sampling
IS . Intensive/Systematic Sampling
DI . . . . . Diurnal Sampling
SS . . . . . Special Studies

**Continuous flow measurements by the USGS are recorded on an hourly basis.*

There are two primary types of data collected at each sampling site: *field and conventional*. Field parameters are collected and utilized as real time indicators of the water quality at each site. Conventional parameters are collected, preserved, and taken back to the laboratory for processing and analysis. **Table 3** provides a list of some of the field and conventional parameters that are currently being collected in the Red River Basin. In addition, the quality-assured data collected by the Authority are entered into the Authority's database and made available on the Authority's website at www.rra.dst.tx.us/data/swqm.

While the Authority is well equipped with its own environmental laboratory, samples collected by TCEQ and USGS are processed by their own in-house laboratories. All sampling entities are required to adhere to a Quality Assurance Project Plan approved by the TCEQ, which ensures that all data collected by the entities sampling within the Red River Basin are quality-assured and verified. Data are then entered into the statewide data collection system administered by the TCEQ known as TRACS (Texas Regulatory Activity and Compliance System).

Samples collected by the Authority are analyzed in the Authority's Environmental Services Division Laboratory

Table 3 – Collected Water Quality Parameters

FIELD PARAMETERS *Collected and processed in the field laboratory. Results are expressed in mg/L except as noted.*	
Temperature:	The temperature of water at the time of collection in degrees Celsius.
pH:	The hydrogen-ion activity of water caused by the breakdown of water molecules and the presence of dissolved acids and bases. pH determines whether a water body is acidic, neutral, or basic.
DO:	Dissolved Oxygen (DO) – The oxygen that is freely available in water. DO is vital to fish and other aquatic life and the prevention of odors. Traditionally, the level of dissolved oxygen has been accepted as the single most important indicator of a water body's ability to support desirable aquatic life.
Conductivity:	A measurement of the electrical current carrying capacity in µmhos/cm of 1 cm^3 of water at 25°C. Dissolved substances such as chloride or sodium in water dissociate into ions with the ability to conduct electrical current. Conductivity, or how well electricity is conducted, is a measure of how salty the water is. Salty water has a high conductivity.
Turbidity:	A measure of clarity of a water sample expressed in NTU's (Nephalometric Turbidity Units). The higher the turbidity, the muddier the water.
Flow Measurement Method:	The manner in which flow is measured, usually by gage or electrical device.
E. coli:	The current indicator bacteria to determine if the water body is suitable for contact recreation. It is expressed in MPN (most probable number) per 100 mL of water. High results on the *E. coli* test can indicate a potential pollution problem. *E. coli* is used as an indicator because it can be potentially harmful to people.
Fecal Coliform:	The former indicator bacteria group used to determine if the water body is suitable for contact recreation. It is expressed in numbers of colonies per 100 mL of water. High results on the fecal coliform tests can indicate a potential pollution problem.
Water Clarity:	Clearness of the water as it appears in the water body at the time of sampling. Clarity ranges from excellent to poor. Clarity is a visual indicator of a water body.

FIELD PARAMETERS (continued) *Collected and processed in the field laboratory. Results are expressed in mg/L except as noted.*	
Water Odor:	Odor of the water, if any. Odors can aid in discovering problems in a water body.
Weather:	Listing of basic weather conditions at the time of sampling. This information is useful as an aid in determining if a particular problem is weather related.
Days Since Last Significant Precipitation:	The number of either estimated or actual days since the last beneficial rainfall event.
CONVENTIONAL PARAMETERS ***Processed in the Authority's ESD Laboratory and our contract laboratory. Results are expressed in mg/L except as noted.***	
Alkalinity:	A measure of the acid-neutralizing capacity of water. Bicarbonate, carbonate, and hydroxide are the primary causes of alkalinity in natural waters. Alkalinity is a measurement of the buffering capacity of water and its capability to neutralize acids.
Ammonia:	Naturally occurring in surface and wastewater, and is produced by the breakdown of compounds containing organic nitrogen. Elevated ammonia levels are a good indicator of organic pollution.
Calcium:	Dissolved metal associated with chloride, sulfate, and alkalinity.
Hardness:	The sum of the calcium and magnesium concentrations in water and is expressed as calcium carbonate.
Chloride:	One of the major inorganic ions in water and wastewater. Concentrations can be increased by industrial processes. High chloride concentrations can affect metallic objects, growing plants, and make water unsuitable for drinking. Chloride compounds, often known as salts, can be an indicator of natural or manmade pollution, as in the case of oil field brines.
COD:	Chemical Oxygen Demand (COD) – A measure of the amount of oxygen required to oxidize all compounds in the water, both organic and inorganic. COD is an indicator of how much organic load is placed on the oxygen in a water body.
Total Phosphorus:	An essential nutrient to the growth of organisms and can be the nutrient that limits the primary productivity of water. In excessive amounts from wastewater, agricultural drainage, and certain industrial wastes, it also contributes to the eutrophication of lakes and other water bodies. Phosphorus is commonly known as a man made pollutant.
Sulfate:	Derived from rocks and soils containing gypsum, iron sulfides, and other sulfur compounds. Sulfides are widely distributed in nature. In high concentrations sulfate can affect taste and cause physical problems in drinking water.
TDS:	Total Dissolved Solids (TDS) – The amount of material (both inorganic salts and organic material) dissolved in water.
TSS:	Total Suspended Solids (TSS) – A measure of the total suspended solids in water, both organic and inorganic.
TOC:	Total Organic Carbon (TOC) is all of the carbon portions, both organic and inorganic, in a water body.
Chlorophyll *a*:	A photosynthetic pigment which is found in all green plants. The concentration of chlorophyll *a* is used to estimate phytoplankton biomass (all of the phytoplankton in a given area) in surface water. Results are expressed in µg/L (micrograms per liter).
Pheophytin:	An important degradation product of chlorophyll *a* and interferes with the measurement of chlorophyll *a*. Pheophytin can cause an over or under estimation of chlorophyll *a*. It is used to determine a more accurate measure of chlorophyll *a*. Results are expressed in µg/L (micrograms per liter).
Nitrate plus Nitrite:	An intermediate oxidation state in the nitrification process (ammonia → nitrate → nitrite or end nitrogen product).
VSS:	Volatile Suspended Solids – A portion of the TSS that is lost after cooking at high temperatures. This represents the organic part of the TSS.

WATER QUALITY DATA REVIEW

The regular program of monitoring and assessment is designed to compare conditions in Texas surface waters to established *water quality standards* and to determine which water bodies are meeting the standards set for their use, and which ones are not. These are fundamental building blocks used to manage the quality of surface water.

Water quality standards were established based on historical hydrological data for each classified waterbody. In the assessment, current water quality data are screened against the appropriate standard in accordance with the *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data*. The results are then analyzed and evaluated for the assessment. The assessment occurs every two years utilizing the previous five years of data. The results are then published periodically in the *Texas Water Quality Inventory and 303(d) List*, as required by Sections 305(b) and 303(d) of the Federal Clean Water Act. In addition, the reports are available online at www.tceq.state.tx.us/compliance/monitoring/water/quality/data/04twqi/04_summary.html.

There are three main aspects of the water quality assessment performed by the TCEQ:

1. The ***Draft 2004 Texas 303(d) List*** identifies water bodies for which effluent limitations are not stringent enough to implement water quality standards. The TCEQ also develops a schedule identifying Total Maximum Daily Loads (TMDLs) that will be initiated in the next two years for priority impaired waters. Water quality permitting in 303(d)-listed water bodies is described in the TCEQ regulatory guidance document *Procedures to Implement the Texas Surface Water Quality Standards*. Water bodies in the Red River Basin which are listed on the *Draft 2004 Texas 303(d)* List include:

Segment	Water Body	Parameter(s)
0201A	Mud Creek	Bacteria
0202D	Pine Creek	Bacteria
0202E	Post Oak Creek	Bacteria
0203A	Big Mineral Creek	Bacteria
0207A	Buck Creek	Bacteria
0211	Little Wichita River	Depressed Dissolved Oxygen Total Dissolved Solids
0214A	Beaver Creek	Depressed Dissolved Oxygen
0218	Wichita/North Fork Wichita River	Selenium (chronic) in Water

Segment	Water Body	Parameter(s)
0218A	Middle Fork Wichita River	Selenium (chronic) in Water
0229	Upper Prairie Dog Town Fork Red River	Depressed Dissolved Oxygen Bacteria
0299A	Sweetwater Creek	Bacteria

2. The ***Draft 2004 Water Quality Inventory Summary of Water Bodies with Concerns for Use Attainment Report*** lists water bodies with concerns identified for indicators, such as dissolved oxygen. These indicators are directly tied to support of designated uses and criteria adopted in the *Texas Surface Water Quality Standards.* Water bodies in the Red River Basin which were identified with use attainment concerns include:

Segment	Water Body	Use Concern	Parameter(s) of Concern
0201A	Mud Creek	Aquatic Life Use	Depressed Dissolved Oxygen
0202D	Pine Creek	Aquatic Life Use	Depressed Dissolved Oxygen
0203A	Big Mineral Creek	Contact Recreation Use	Bacteria
0220	Upper Pease/North Fork Pease River	General Use	Temperature

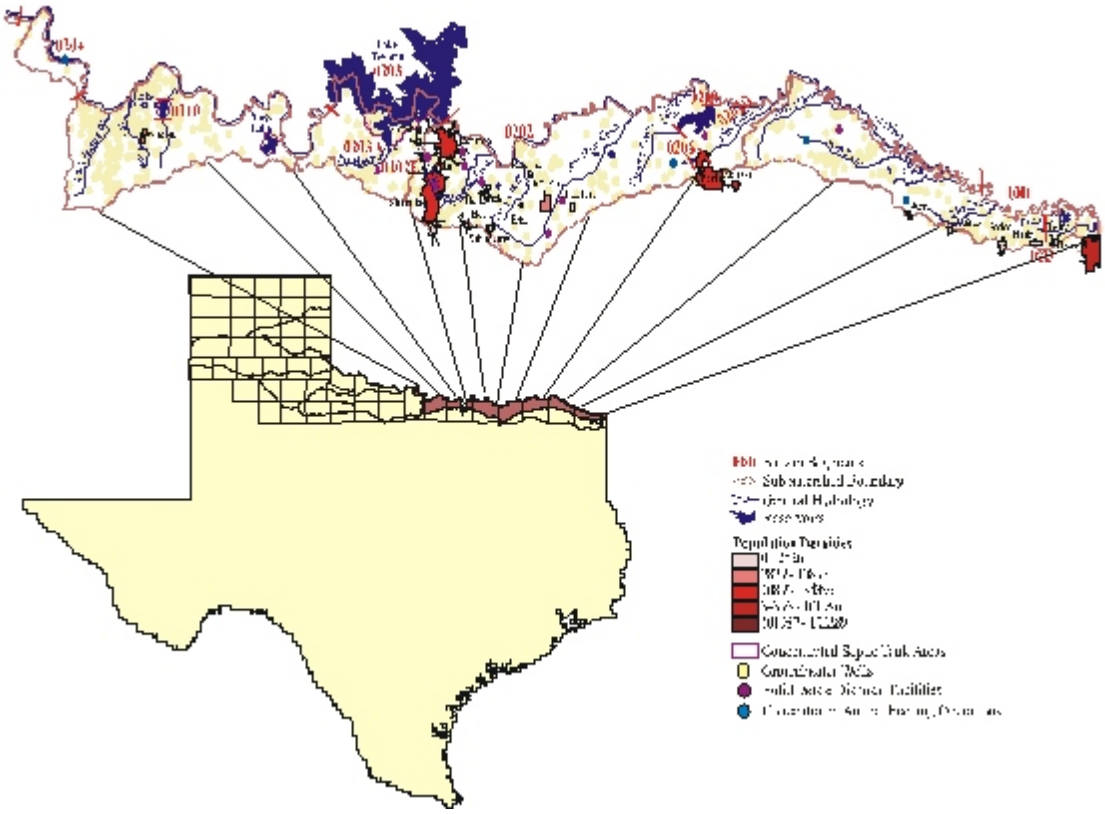
3. The ***Draft 2004 Water Quality Inventory Summary of Water Bodies with Water Quality Concerns*** identifies water quality concerns in water bodies with indicators such as nutrients that are not tied to support of a designated use with a quantitative criterion. Screening levels used to identify these concerns have generally not been adopted as standards with the exception of secondary drinking water standards. Water bodies in the Red River Basin which are included on the summary of water bodies with water quality concerns are as follows:

Segment	Water Body	Use Concern	Parameter(s) of Concern
0202D	Pine Creek	Nutrient Enrichment	Ammonia Orthophosphorus
0202E	Post Oak Creek	Narrative Criteria	Excessive Algal Growth

Segment	Water Body	Use Concern	Parameter(s) of Concern
0203	Lake Texoma	Public Water Supply	Chloride, Sulfate, and Total Dissolved Solids in Finished Drinking Water Increased Costs due to Demineralization
0204	Red River above Lake Texoma	Algal Growth	Excessive Algal Growth
0205	Red River below Pease River	Algal Growth	Excessive Algal Growth
0211	Little Wichita River	Algal Growth	Excessive Algal Growth
0214	Wichita River below Diversion Lake Dam	Algal Growth Nutrient Enrichment Sediment Contaminants	Excessive Algal Growth Ammonia Orthophosphorus Total Phosphorus Nickel in Sediment
0214A	Beaver Creek	Nutrient Enrichment	Ammonia
0216	Wichita River below Lake Kemp Dam	Nutrient Enrichment	Ammonia
0220	Upper Pease/North Fork Pease River	Nutrient Enrichment	Ammonia
0226	South Fork Wichita River	Nutrient Enrichment	Ammonia
0229	Upper Prairie Dog Town Fork Red River	Nutrient Enrichment	Nitrate+Nitrite Nitrogen Orthophosphorus Total Phosphorus
0229A	Lake Tanglewood	Algal Growth Nutrient Enrichment	Excessive Algal Growth Nitrate+Nitrite Nitrogen Orthophosphorus Total Phosphorus

For more information about the evaluation of water quality data for the Texas Water Quality Inventory Assessment, please see the TCEQ's *Guidance for Assessing Texas Surface and Finished Drinking Water Quality Data* at www.tceq.state.tx.us/assets/public/compliance/monops water/04twqi/04_guidance.pdf.

Reach I of the Red River Basin begins at Texarkana in Bowie County and ends upstream inside Clay County, east of Wichita Falls. This area consists of several communities including the Sherman and Denison area, which has recently become one of the fastest growing areas in the state due to the expansion of the Dallas/Fort Worth Metroplex. Other cities within **Reach I** include Bonham, Bowie, Clarksville, Nocona, Texarkana, Paris, and Gainesville.



Segments contained in **Reach I** include:

0201 - Lower Red River
0201A - Mud Creek
0202 - Red River below Lake Texoma
0202A - Bois D'Arc Creek
0202C - Pecan Bayou
0202D - Pine Creek
0202E - Post Oak Creek
0202F - Choctaw Creek
0203 - Lake Texoma
0203A - Big Mineral Creek
0204 - Red River above Lake Texoma
0204B - Moss Lake
0208 - Lake Crook
0209 - Pat Mayse Lake
0210 - Farmers Creek Reservoir
0225 - McKinney Bayou

Reach I contains 42 municipal and industrial waste water dischargers, 42 solid waste disposal sites, of which eight sites are currently active. Additionally in this reach there are over 1,200 groundwater wells and two hazardous waste sites. Also, based on recent permit data, there are no permitted concentrated animal feeding operations in this reach.

Farms and ranches in this reach produce mainly wheat, hay, soybeans, corn, milo, cotton, sorghum, turf grasses, wholesale nursery greenery, plus pecans, peaches, melons, peanuts, beef cattle, poultry, goats, dairy cattle, and horses. Mining of limestone, gravel, lignite, bituminous coal, sand, and gravel is also conducted in this reach of the basin.

During the reference period of September 1, 2004 through August 31, 2005, the Authority conducted 71 monitoring events and collected approximately 1,730 parameters from 14 water quality monitoring stations. The TCEQ conducted 48 monitoring events and collected about 777 parameters from 10 water quality monitoring stations. **Figure 2** illustrates the monitoring coverage of **Reach I**, where each monitoring station is designated by a five digit numeric code.

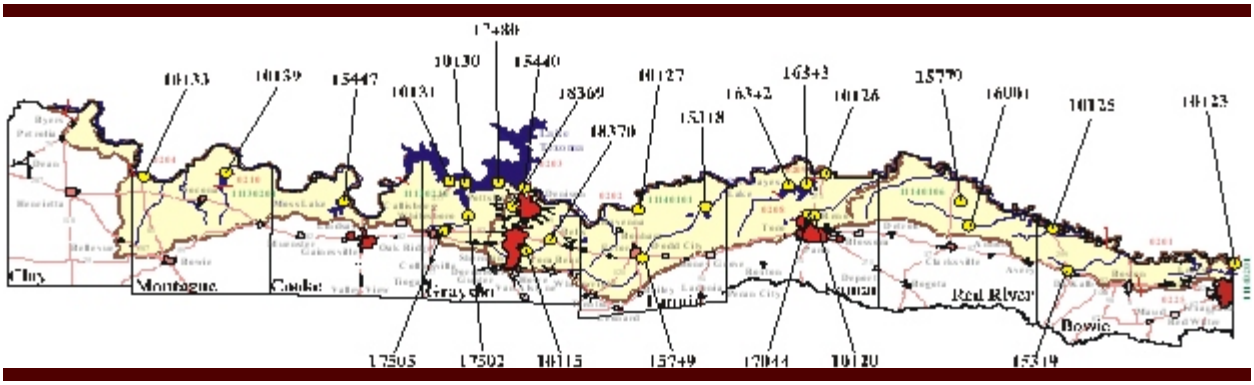


Figure 2

Segment 0201, Lower Red River, is the lowest segment in the drainage of the Red River Basin. The *Draft 2004 Texas Water Quality Inventory, May 13,2005* lists this segment as fully supporting its overall uses and meeting its criteria. The Authority's review of the current data revealed elevated chlorophyll *a* levels which could possibly lead to a nutrient enrichment concern for excessive algal growth. Since the mainstem of the Red River receives drainage from both Texas and Oklahoma, this segment is influenced by factors from both sides of the river. Coordination and cooperation from regulatory agencies of both states are recommended to manage the water quality in the mainstem.

Segment 0201A, Mud Creek is a minor tributary of the Red River and is listed on the *Draft 2004 Texas Water Quality Inventory* and the *Draft 2004 Texas 303(d) List* dated May 13, 2005 as not supporting its contact recreation use due to elevated bacteria levels. In addition, it is listed for not supporting aquatic life use due to depressed oxygen levels. The Authority's review of the data agreed with the inventory and also found that Mud Creek has experienced elevated levels of ammonia, total phosphorus, and chlorophyll *a*. Usually, elevated phosphorus levels are an indication of some kind of human pollution activities; and when high levels of ammonia are found in natural waters, it is usually an indication of sanitary pollution, animal waste byproducts, or fertilizer run-off. Mud Creek has been classified as a perennial stream (continuously flows), but as a result of the ongoing drought and beaver dams located in the creek, it has become intermittent with perennial pools. The sampling site for Mud Creek is located in a small stagnant pool that has become covered with duck weed. Only the return of normal seasonal rainfall would improve the condition of this water body.

The *Draft 2004 Texas Water Quality Inventory, May 13, 2005,* lists **Segment 0202, Red River below Lake Texoma**, as currently fully supporting its overall uses and meeting its criteria. However, the Authority's review of the current data revealed elevated chlorophyl *a* levels which exceeded the screening criteria. Since the Red River receives run-off and in-flow from not only Texas, but also from Oklahoma, coordination and cooperation from both states is recommended to achieve rectification of this issue.

The *Draft 2004 Texas Water Quality Inventory, May 13, 2005*, lists **Segment 0202A, Bois D' Arc Creek**, as meeting its overall uses and criteria. A recent data review by the Authority indicated that additional data are needed to properly assess this water body since this segment is the site of a proposed water supply/flood control lake.

Pecan Bayou at FM 1159

Segment 0202C, Pecan Bayou was not assessed according to the *Draft 2004 Texas Water Quality Inventory, May 13, 2005.* This generally means that there were not enough data on file during the listed assessment period for the segment to be assessed and that sample collections should continue until enough data sets are collected. Since the Authority has started monitoring Pecan Bayou, it has used this water body as a reference stream. A reference stream is a stream that has few or no known water quality problems. However, recent data

review by the Authority has indicated that Pecan Bayou is experiencing some depressed dissolved oxygen levels. As the drought has influenced all areas of the Red River Basin, this watershed is no exception. Over the years Pecan Bayou has been found to fluctuate from being a full flowing creek to completely drying up, leaving only a few stagnant puddles. The Authority will continue to use Pecan Bayou as a reference stream and a regional indicator of drought conditions.


Pine Creek at US 271

The *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005 lists **Segment 0202D, Pine Creek**, as not meeting its contact recreation use due to elevated bacteria levels. In addition, it is listed for a nutrient enrichment concern for elevated levels of ammonia nitrogen and orthophosphorus. The Authority's review of the recent data concurs with that assessment and also revealed elevated total phosphorus levels. The monitoring site on Pine Creek where most of the data has been collected is approximately 1.5 stream miles from the spillway of Lake Crook. Smith Creek, a tributary and a major contributor to the flow and volume of this portion of Pine Creek receives run-off from the watershed of the northwest section of the City of Paris' industrial district. Further investigation and supplemental sampling has revealed that the use support and concerns are most likely originating from Smith Creek. The Smith Creek monitoring site is located a short distance upstream from its confluence with Pine Creek. Both the Pine and Smith Creeks' monitoring sites are on State Highway 271, just north of the City of Paris. Generally, Pine Creek does not have a large flow since the creek has been dammed to form Lake Crook. When Pine Creek is actively flowing, samples collected from monitoring sites on both Pine Creek and Smith Creek suggest the elevated levels are originating in the Smith Creek tributary, not Pine Creek. At those times of the year when Lake Crook is not spilling excess water over the spillway, typically in late summer, Pine Creek may be found flowing in a reverse direction because the flow from Smith Creek is so strong that it backs up into Pine Creek. Although both creeks are in the same watershed, there have been many instances when the data collected from both sites on the same day will vary significantly, with Smith Creek exhibiting greater values than Pine Creek. Rectifying the water quality issues in this segment will be difficult. To bring this watershed back into compliance, cooperation from local entities will be essential to bring about the changes that are necessary to restore the Pine Creek watershed.


Post Oak Creek at FM 1417

Segment 0202E, Post Oak Creek is listed on the *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005 as not meeting its contact recreation use due to elevated bacteria levels. In addition, it also is listed for excessive algal growth. Basically, Post Oak Creek winds its way through the City of Sherman, from a point northwest of the city diagonally through to the southeast. Post Oak Creek is basically a storm drainage creek for much of the city. The Authority's review of the more recent data indicates that Post Oak Creek can exhibit high bacterial spikes after rainfall events, but normally the creek is in compliance. In the review of the data, an exceedance in total phosphorous was observed. This can be attributed to the type of run-off that is expected from drainage that flows through a city. The Authority and its new cooperating partner, the City of Sherman, are working jointly to more effectively monitor the health of Post Oak Creek.

Segment 0202F, Choctaw Creek is currently fully supporting its overall use criteria according to the *Draft 2004 Texas 303(d) List and the Draft 2004 Texas Water Quality Inventory, May 13, 2005*. With recent limited data, the Authority's review revealed that Choctaw Creek has experienced elevated bacteria, nitrate+nitrite, total phosphorus, and orthophosphate. After research, it seems the elevated nutrients are developing due to a treated effluent discharge located in the upper portions of the creek. Bacterial levels may be caused by agricultural runoff. Although the wastewater treatment plant is discharging within its permitted guidelines, the effluent is still higher than the criteria and standards set for this creek. This situation is not unusual and is the case for most wastewater treatment plants.


Lake Texoma at Denison Dam

The *Draft 2004 Texas Water Quality Inventory, May 13, 2005*, lists **Segment 0203, Lake Texoma** as supporting its overall uses and meeting its criteria. However, the lake is listed has having overall public water supply concerns for increased costs due to demineralization for elevated levels of chloride, sulfate, and total dissolved solids in finished drinking water. With recent limited data, the Authority's review is in agreement with its listing on the inventory. These public water supply concerns on Lake Texoma will not be resolved without the full cooperation of both Texas and Oklahoma, federal environmental agencies, and any other interest groups in this project.

Until the Chloride Control Project is completed and the rivers and the lake are flushed of the chloride and sulfate components, Lake Texoma will continue to be listed as having an overall public water supply concern on the *Texas Water Quality Inventory*.

Segment 0203A, Big Mineral Creek is listed on the *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005 for not meeting its contact recreation use due to elevated bacteria levels. Review of the recent data revealed that Big Mineral Creek is now meeting the standard for contact recreation use for bacteria and is currently in the process of being removed from the 303(d) List.

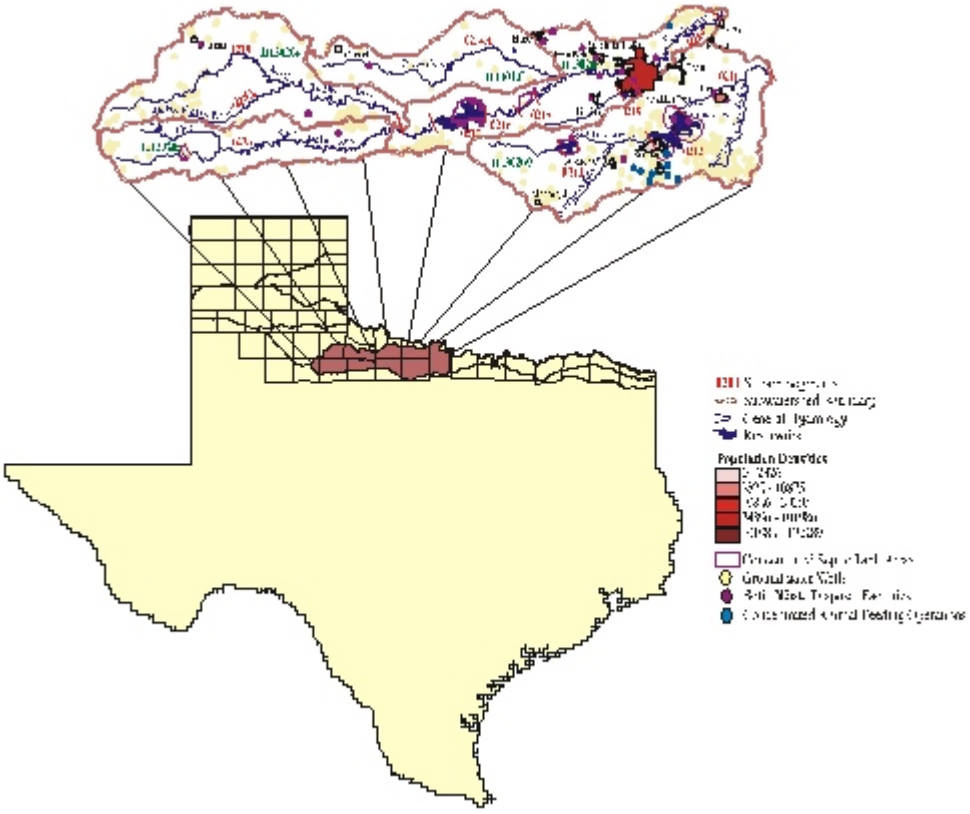
The *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005 lists **Segment 0204, Red River above Lake Texoma** with an algal growth concern due to elevated chlorophyll *a* levels. The Authority's review of the available data concurs with this assessment. Without having data and physical observations from the Oklahoma side of the watershed, it is difficult to form any findings or postulate any theories as to the nature of the elevated chlorophyll *a* levels. Chlorophyll *a* is almost always found as a result of some kind of human exploitation of the watershed, such as fertilizer run-off, leakage from aging septic systems, or from wastewater treatment plants. Data from Chlorophyll *a* can be used as an indirect indicator of nutrient levels or the eutrophication of river or lakes.

Segments 0204B-Moss Lake, 0208-Lake Crook, 0209-Pat Mayse Lake, 0210-Farmers Creek Reservoir, and **0225-McKinney Bayou** were not assessed for the *Draft 2004 Texas Water Quality Inventory, May 13, 2005*. This generally means there were not enough data sets on file during the listed assessment period for that segment to be properly assessed and water quality monitoring should continue until enough data are available.

In February 2004 the Authority contracted with the TCEQ to conduct an 18 month long flow monitoring study for permitting support purposes on two sites in **Reach I**: Bois D'Arc Creek and an unnamed tributary of Lake Texoma, and one site in **Reach III**, Groesbeck Creek. The study on these sites was completed in July 2005, at which time the Authority submitted a complete report to the TCEQ on its findings. This report can be viewed on the Authority's website at www.rra.dst.tx.us.

Reach II represents the Wichita River and Little Wichita River watersheds from the confluence of the Red River to their headwaters, which begins in Clay County and continues westward to Dickens County. The largest city within this reach is Wichita Falls, with a population of 104,200.

Reach II is a large, diverse area with most of the large population centers located in the eastern portion, while the western portion contains some of the largest ranches in the state, including the W.T. Waggoner Estate, Four Sixes Ranch, and several others.



Segments contained in **Reach II** include:

0211 - Little Wichita River
0212 - Lake Arrowhead
0213 - Lake Kickapoo
0214 - Wichita River below Diversion Lake
0214A - Beaver Creek
0214B - Buffalo Creek
0214C - Holliday Creek
0215 - Diversion Lake
0216 - Wichita River below Lake Kemp
0217 - Lake Kemp
0218 - Wichita/North Fork Wichita River
0218A - Middle Fork Wichita River
0219 - Lake Wichita
0219A - Holliday Creek above Lake Wichita
0226 - South Fork Wichita River

There are approximately 1,600 groundwater wells in **Reach II** located primarily in the Seymour and Trinity Aquifers. However, in the far western portion of the reach, the Ogallala Aquifer is the primary supply.

There are 18 wastewater outfalls, six permitted concentrated animal feeding operations, and 45 solid waste disposal sites, of which seven sites are active. Farming and ranching within the ten-county area include wheat, grains, hay, alfalfa, sorghum, cotton, pecans, peanuts, peaches, watermelons, beef cattle, cow/calf operations, dairies, horses, and some swine and goats.

In portions of **Reach II**, oil and gas fields dominate the landscape. In other areas of the reach, farming or pasture lands are predominate. Natural resource industries include some surface mining for copper, building stone, sand, gravel, volcanic ash, bituminous coal, and components for tile and ceramics.

During the reference period of September 1, 2004 through August 31, 2005, the Authority conducted 16 monitoring events and collected approximately 464 parameters from four water quality monitoring stations. The TCEQ conducted 37 monitoring events and collected around 669 parameters from nine water quality monitoring stations. **Figure 3** illustrates the monitoring coverage of **Reach II**, where each monitoring station is designated by a five digit numeric code.

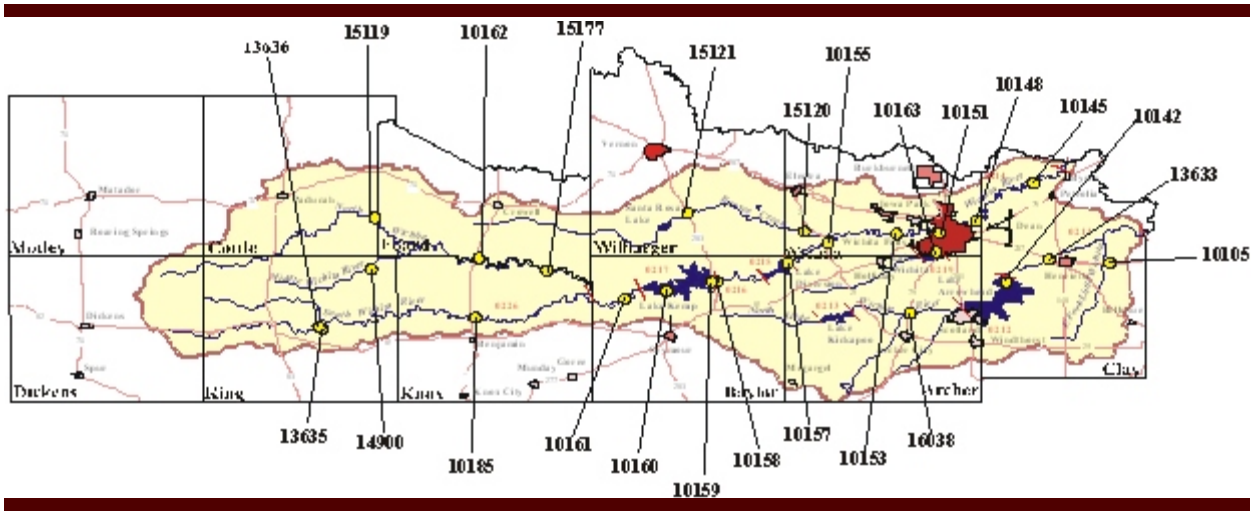


Figure 3

Segment 0211, Little Wichita River, is located below the dam of Lake Arrowhead to the confluence of the Red River. The *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005, lists the Little Wichita River as not supporting its general use due to elevated total dissolved solids levels. In addition, it does not meet aquatic life use criteria due to depressed dissolved oxygen levels. The Authority's review of recent data indicates that the elevated level of total dissolved solids are within standards. However, the data also revealed elevated chlorophyll *a* levels which could result in a future excessive algal growth concern. The ecosystem and habitat of this river are dictated by the lack of continuous flow in the river. The City of Henrietta has a contract with the City of Wichita Falls to divert water into the river so that

Henrietta can capture the diversion behind a low water dam and pump it into a small city lake for drinking water purposes. The nature of the Little Wichita River, with the protracted periods of little or no rainfall, combined with possible intrusions of oil field brine, could have caused the elevated total dissolved solids. However, since the region has been receiving much needed rainfall, these total dissolved solid levels have been diluted and dropped. The elevated chlorophyll *a* levels can be attributed to periods when the river does not have significant flow, allowing algae to multiply rapidly in the stagnant water, utilizing the nutrients that become trapped in the sluggish river.

The *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005, lists **Segment 0212, Lake Arrowhead** as fully supporting its overall uses and meeting its criteria. The Authority's recent data review revealed elevated levels of total phosphorus and orthophosphate. Although the criteria for these nutrients are more stringent on lakes than in river systems, the exceedances on Lake Arrowhead may be attributed to run-off from several dairy farms located in the upper portions of the watershed. In most reservoirs, total phosphorus is the nutrient that is generally elevated, but in Lake Arrowhead, orthophosphate is also elevated. Lake Arrowhead is one of two major sources of drinking water for the City of Wichita Falls.

Segment 0213, Lake Kickapoo, is located upstream of Lake Arrowhead, and is also a primary source of drinking water for the City of Wichita Falls. Although recent data are limited on this segment, the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* lists Lake Kickapoo as fully supporting its overall uses and meeting its criteria. Additional data are needed on Lake Kickapoo to conduct a complete assessment on this waterbody.

Wichita River at FM 810

Segment 0214, Wichita River below Lake Diversion, is listed on the *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005, as having an overall nutrient enrichment concern and a concern for excessive algal growth. This portion of the Wichita River meanders from the dam of Lake Diversion to its confluence with the Red River. The Authority's review of the available data indicated elevated bacteria and nutrient levels. The elevated bacteria levels, the nutrient enrichment, and the concerns for excessive algal growth which occur up

and down the river are most likely a result of run-off from the more densely populated areas of the watershed. Possible sources include; a large fish hatchery, some mid-sized cattle ranching operations, five permitted dischargers, thousands of acres of farm land, and numerous septic tanks of undetermined age and condition which could leach and/or drain directly into the river.

Segment 0214A, Beaver Creek, is listed on the *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* as not meeting its aquatic life use for depressed dissolved oxygen. Although recent data indicate an improvement, Beaver Creek will remain on the *303(d) List* until a sufficient number of 24-hour measurements are available to demonstrate support of the criteria. The Authority's review of the data from Beaver Creek indicates there have been exceedances for bacteria and nutrients in this segment. The area surrounding the creek is open pasture with oilfield activities. The farmland is mainly dryland with a few irrigated fields. Although stock tanks scatter the landscape, livestock and wildlife still use the creek as a water source. Run-off from the fields and pastures are likely the source of the elevated bacteria and nutrient levels.


Beaver Creek at US 283

The *Draft 2004 Texas Water Quality Inventory, May 13, 2005* lists **Segment 0214B, Buffalo Creek**, as fully supporting its overall uses and criteria. There have been no data collected on this waterbody since early 1999, therefore the Authority has included Buffalo Creek in its 2007 water quality monitoring schedule.

Segment 0214C, Holliday Creek, flows from the Lake Wichita Dam down through the City of Wichita Falls to its confluence in the city. Although there is no recent data to assess, the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* lists Holliday Creek as fully supporting its overall uses and meeting its criteria.

The *Draft 2004 Texas Water Quality Inventory, May 13, 2005,* lists **Segment 0215, Lake Diversion**, as not assessed. This generally means there were not enough data on file during the listed assessment period for that segment to be assessed properly. Sample collections should continue until enough data are collected and a proper assessment can be performed.


Lake Diversion

Lake Diversion is unique in that it was constructed as a flood control impoundment and a source for irrigation water supply. When work on the lake was completed, the vast network of irrigation canals and ditches that crisscrossed Archer and Wichita Counties were able to supply landowners with a low cost irrigation source. Over time the build up of chloride and sulfate in the lake has rendered it almost useless as a viable water supply. Reduction of the salts in Lake Diversion would revitalize the watershed and would allow the reservoir to be utilized as a water supply.

Segment 0216, Wichita River below Lake Kemp, is listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005,* as fully supporting its overall uses, but having a nutrient enrichment concern for elevated ammonia-nitrogen. This segment of the Wichita River is located between the dam of Lake Kemp and the headwaters of Lake Diversion. Usually, when high levels of ammonia are present in natural waters, it is an indication of sanitary pollution, animal waste byproducts, or fertilizer run-off.

The *Draft 2004 Texas Water Quality Inventory, May 13, 2005,* lists **Segment 0217, Lake Kemp**, as fully supporting its overall uses and meeting its criteria. The Authority's recent review of the data reveals no exceedances in the waters of Lake Kemp. Lake Kemp, like Lake Diversion, was built as a water supply and flood control lake and is operated and maintained by the Wichita County Water Improvement Water District Number Two.

Over time the build up of chloride and sulfate in the lake has rendered it almost useless as a viable water supply. Reduction of the salt in Lake Kemp would revitalize the watershed and would allow the reservoir to be utilized as a water supply.

Segments 0218 - Wichita/North Fork Wichita River and **0218A - Middle Fork Wichita River** are listed on the *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory, May 13, 2005,* for not supporting their aquatic life uses for elevated selenium (chronic) in water. Selenium is an essential trace element that is required in human and animal nutrition. However, the average levels found in these two forks of the Wichita River are well above the criteria established for fresh waters.

The conductivity of these water bodies is very comparable to that of sea water and makes the water brackish (a mixture of salty and fresh water). The TCEQ criteria for tidal water is 136 mg/L, as opposed to 5 mg/L for fresh waters. The fresh water standard does not adequately describe the nature of these two water bodies. A review of the standards for these segments on how selenium relates to brackish waters should be initiated and perhaps the standards raised for segments in this region.

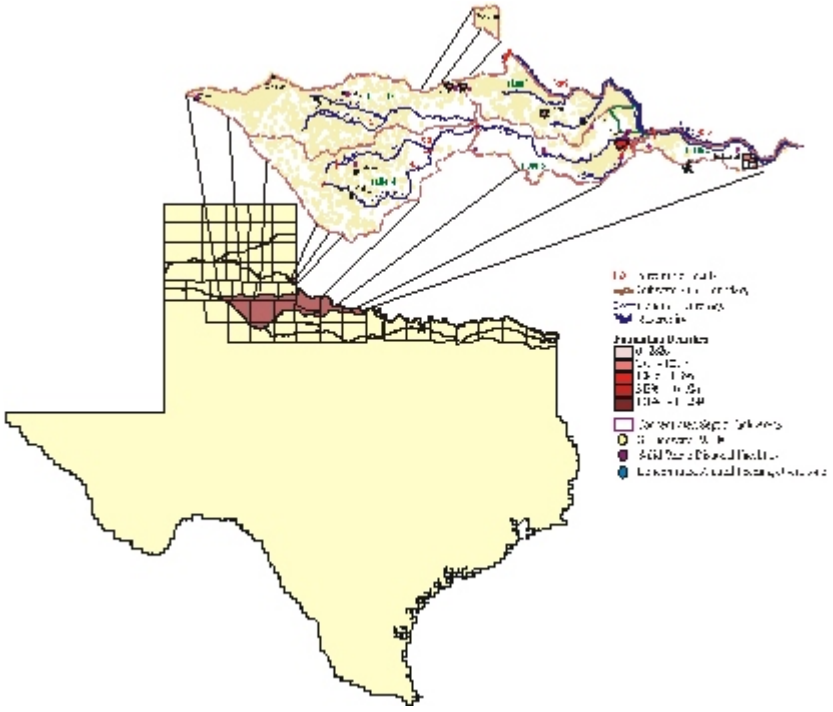
The *Draft 2004 Texas Water Quality Inventory* dated May 13,2005 lists **Segment 0219 Lake Wichita** as not assessed. This means there were not enough data on file during the listed assessment period to be assessed properly. Sample collections should continue until enough data are collected for a proper assessment. The Authority's review of the current data concurs.

Segment 0219A, Holliday Creek above Lake Wichita, is listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* as fully supporting its overall uses and criteria. There have been no data collected on this waterbody since August of 1997, therefore the Authority has included Holliday Creek in its 2007 Water Quality Monitoring Schedule.

Segment 0226, South Fork Wichita River, is listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* with a nutrient enrichment concern due to elevated ammonia levels. The Authority's review of the data agrees with this assessment. The source of the ammonia is most likely the result of naturally occurring salt springs in this watershed.

South Fork Wichita River

Reach III begins in northern Wichita County and proceeds westward toward Floyd and Briscoe Counties, involving the Pease River watershed from the confluence of the Red River to its headwaters. It includes the Red River main stem from the confluence of Cache Creek upstream to the confluences of Buck Creek and the Red River. The cities of Vernon and Burkburnett with populations of 11,700 and 11,000, respectfully, are the largest within the reach. The reach's total population is only about 26,000.



Reach III contains 14 wastewater dischargers, 25 solid waste disposal sites, six of which are active. Based on recent permit data, there are no permitted concentrated animal feeding operations in this reach. Additionally, approximately over 3,600 groundwater wells utilize water from the Seymour, Blaine, and Ogallala Aquifers.

Comprised mainly of agribusiness and oil and gas production, **Reach III** is predominately rural in nature. The farms and ranches in the area produce cotton, wheat, hay, feed products, guar, alfalfa, soybeans, sorghum, peanuts, sunflowers, beef cattle, horses, hogs, poultry, and sheep.

Segments contained in **Reach III** include:

0205 - Red River below Pease River
0206 - Red River above Pease River
0206A - Groesbeck Creek
0220 - Upper Pease/North Fork Pease River
0221 - Middle Fork Pease River
0227 - South Fork Pease River
0230 - Pease River
0230A - Paradise Creek

During the reference period from September 1, 2004 through August 31, 2005, the Authority conducted 19 monitoring events and collected approximately 386 parameters from three water quality monitoring stations. The TCEQ conducted 22 monitoring events and collected around 504 parameters from five monitoring stations. **Figure 4** below illustrates the monitoring coverage of **Reach III**, where each monitoring station is designated by a five digit numeric code.

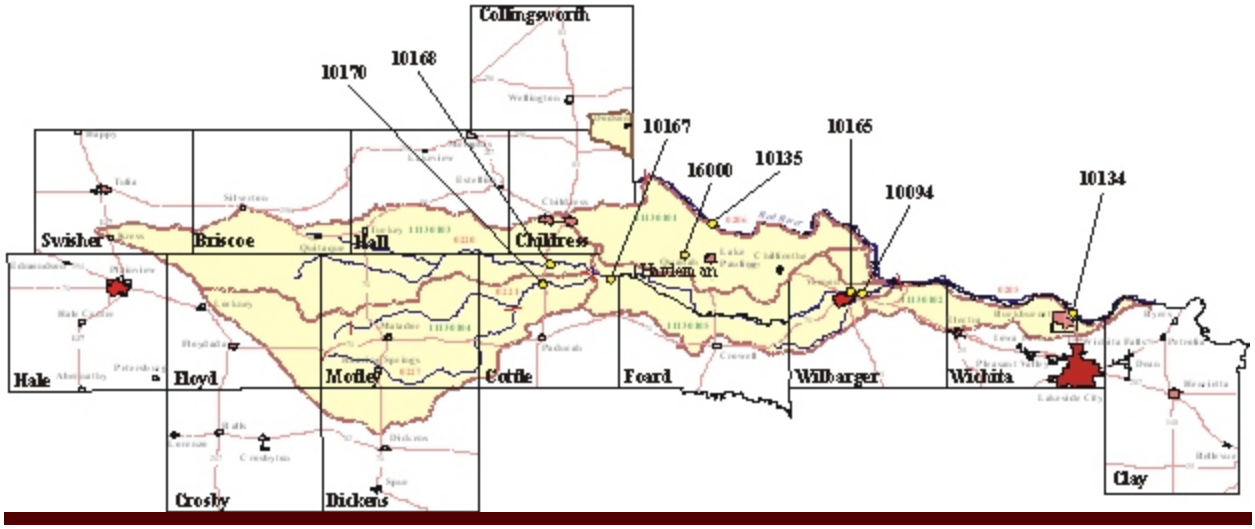


Figure 4

Segment 0205, **Red River below Pease River** is listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* as fully supporting its overall uses and meeting its criteria. The Authority's review of the current data concurs with this assessment.

The *Draft 2004 Texas Water Quality Inventory, May 13, 2005* lists **Segment 0206, Red River above Pease River,** as not assessed. This generally means that there were not enough data on file during the listed assessment period for that segment to be properly evaluated. Sample collections should continue until enough data are available.

Segment 0206A, Groesbeck Creek is listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* as fully supporting its overall uses and meeting its criteria. Groesbeck Creek is a tributary to the Pease River. The pastures and fields surrounding the creek are utilized by local ranchers as a place to graze cattle. The Authority's review of the data found this segment to exceed the stream standards for bacteria. It is most likely that the livestock and/or wildlife gathering in and around the creek for water are causing this increase in bacteria.

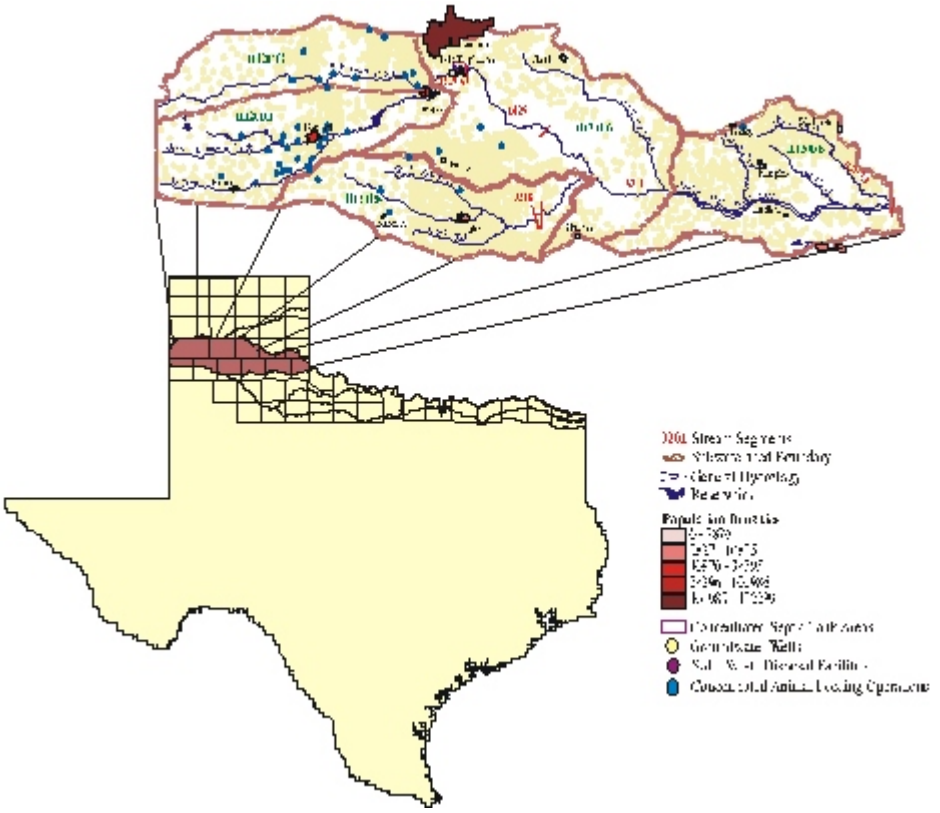
Segment 0220 the Upper Pease / North Fork of the Pease River is listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* as fully supporting it overall uses and meeting its criteria. However, the *2002 303(d) List and Water Quality Inventory* lists this segment as having a use concern for temperature and a nutrient enrichment concern for ammonia. The temperature issue is naturally occurring and most likely the ammonia is from salt springs in the watershed. The Authority's review of the data found that bacteria exceeded contact recreation standards. Although much of the area is under dryland cultivation, areas along and near the river remain rugged and broken. This region is also suitable for ranching as the river can supply the necessary water for the livestock.

The *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005 lists **Segments 0221-Middle Fork of the Pease River and 0227-South Fork of the Pease River** as not assessed. There were insufficient data from these segments to make any significant assessments. These forks of the Pease River have not had sustained significant flows for a long period of time.

Segment 0230, Pease River is listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005 as* fully supporting its overall uses and meeting its criteria. This segment was split off of Segment 0220, the Upper Pease / North Fork of the Pease River, after it was determined that there was a significant difference in distance and in water quality. The Authority's review of the current data revealed elevated levels of ammonia. The source of the ammonia is most likely the result of naturally occurring salt springs in this watershed, or other unknown sources.

The Authority contracted with the TCEQ to conduct an 18 month-long, flow monitoring study for permitting support purposes on Groesbeck Creek. The flow study on this site continued until July 2005, at which time the Authority submitted a complete report to the TCEQ on its findings. The report can be viewed in its entirety on the Authority's website at www.rra.dst.tx.us.

Reach IV begins in Childress County at the Texas/Oklahoma state line and continues through the Panhandle to Deaf Smith and Parmer Counties at the New Mexico state line. It encompasses the Prairie Dog Town Fork of the Red River from the confluence of Buck Creek. The uppermost part of the reach dissects the City of Amarillo, which is also the largest city in the Red River Basin. The towns of Hereford and Canyon have populations of over 14,600 and 12,900 respectively. Approximately 66 other towns and communities are located in **Reach IV** including Childress, Dimmitt, Friona, Tulia, Wellington, and Claude.



Segments contained in **Reach IV** include:

0207 - Lower Prairie Dog Town Fork of the Red River
0207A - Buck Creek
0228 - Mackenzie Reservoir
0229 - Upper Prairie Dog Town Fork of the of the Red River
0229A - Lake Tanglewood

The Ogallala Aquifer lies below the western area of this reach, and provides water for over 5,600 groundwater wells. Included in this watershed are seven wastewater outfalls and 30 solid waste disposal sites, seven of which are active. In addition, **Reach IV** includes one industrial hazardous waste site, and 63 permitted concentrated animal feeding operations.

Estelline Salt Springs is a group of natural brine springs located less than a mile east of Estelline, Texas in east-central Hall County on the flood plain of the Prairie Dog Town Fork of the Red River. The springs became active in the late 1800's and washed out a funnel in the alluvium. In 1964 the United States Army Corps of Engineers (USACE) built a dike around the springs to contain the flow and prevent the salt from entering the river system. Since then, the spring water has become more saline.

Cattle ranching plays a significant role in this area of the state, **Reach IV** contains many farms and ranches that produce beef cattle, cotton, wheat, corn, sugar beets, soybeans, sorghum, and potatoes.

During the reference period from September 1, 2004 through August 31, 2005, the Authority conducted 12 monitoring events and collected approximately 348 parameters from three water quality monitoring stations, while the TCEQ conducted 16 monitoring events and collected around 308 parameters from four monitoring sites. **Figure 5** illustrates the water quality monitoring coverage of **Reach IV**, where each monitoring station is designated by a five digit numeric code.

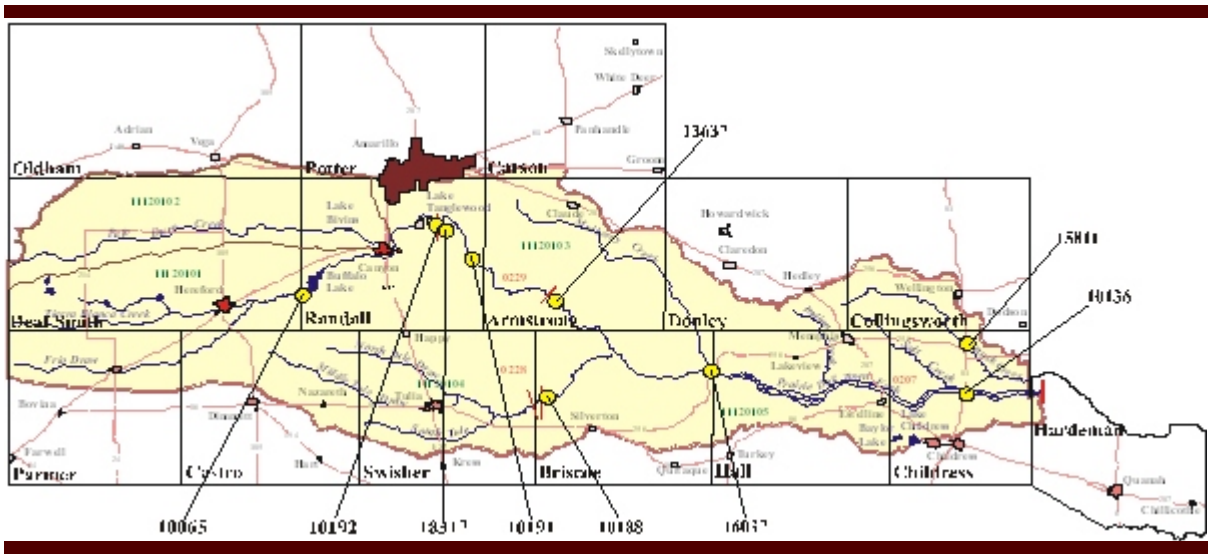


Figure 5

The *Draft 2004 Water Quality Inventory Summary of Water Bodies with Water Quality Concerns, May 13, 2005,* identifies **Segment 0207**, **Lower Prairie Dog Town Fork of the Red River,** as supporting all uses and not experiencing any nutrient enrichment or excessive algal growth concerns. The Authority's review of recent data revealed elevated chlorophyll *a* levels. Although the river flows through some very rugged country and receives run-off from fields within the watershed, it is also possible that contributing flow from Segment 0229, Upper Prairie Dog Town

Fork (UPDTF) of the Red River could be influencing sample results for this stream.

Segment 0207A, Buck Creek is listed on the *Draft 2004 Texas 303(d) List, (May 14, 2005)* for not supporting its contact recreation use due to elevated bacteria levels. The Authority's review of the data available in the TRACS database agrees with the TCEQ assessment. Currently, a *Bacterial Monitoring Study* on Buck Creek is being conducted by the Texas State Soil and Water Conservation Board (TSSWCB) to ascertain the elevated bacterial levels found in the creek. The Authority's data review also revealed elevated nitrate+nitrite nitrogen levels in Buck Creek. This, in conjunction with the elevated bacteria levels, could be caused by watershed run-off after precipitation events, or it could be an indication of interference or activity resulting from inadvertent human pollution activities. Since the TSSWCB's study includes genotyping of the elevated bacterial levels, it is possible the results of their study will reveal the source of pollution in this stream. The Texas Water Resources Institute (TWRI) maintains a website containing information about the project and can be viewed at http://twri.tamu.edu/buckcreek.

The *Draft 2004 Texas 303(d) List, May 13, 2005* identifies **Segment 0229, UPDTF Red River** for not supporting its contact recreation use due to elevated bacterial levels. It also lists this segment for not supporting aquatic life use due to depressed dissolved oxygen. In addition, Segment 0229 is listed on the *Draft 2004 Water Quality Inventory, May 13,2005*, as having a nutrient enrichment concern due to elevated levels of nitrate+nitrite nitrogen, orthophosphorus, and total phosphorus. Recent review of the data by the Authority has revealed the data for grab dissolved oxygen meets the criteria, however the standard is based on 24-hour test data and until sufficient data are collected, this site will remain listed for depressed dissolved oxygen. Possible sources for this concern could be from nutrient-rich discharge from Lake Tanglewood and/or from treated effluent from a local municipal wastewater treatment plant. Additionally, the Authority's data review revealed excessive chlorophyll *a* levels, which could possibly result in a concern for excessive algal growth.

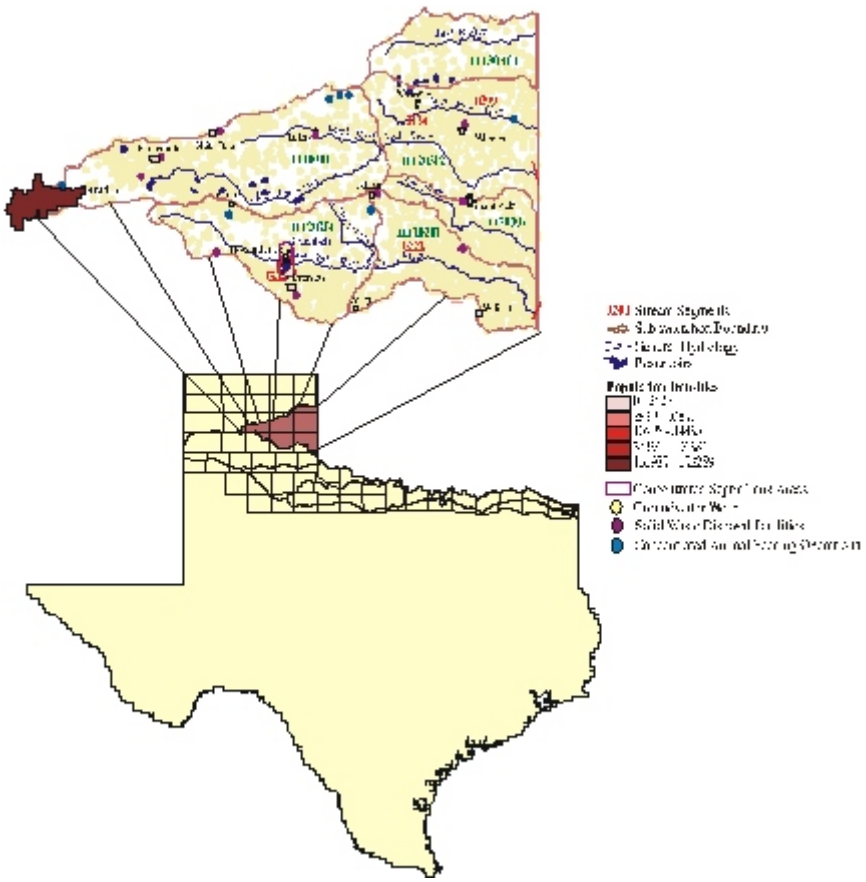
Segment 0229A, Lake Tanglewood is listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005,* for a nutrient enrichment concern due to elevated levels of nitrate+nitrite nitrogen, orthophosphorus, and total phosphorus. In addition, it is listed with an excessive algal growth concern due to elevated chlorophyll *a* levels. The Authority's recent review of the current data from Lake Tanglewood agrees with the inventory listings, however, exceedances for chloride and pH levels were also revealed. Possible sources of the nutrient and algal growth could be from run-off from rainfall events or leaks from aging septic tanks in the community that surrounds the lake. It is interesting to note that the available chloride data are showing the values decreasing over time due to the increase of precipitation received in 2005. The pH issues will likely be elevated as long as the excessive algal growth concerns remain. In most cases, elevated phosphorus levels are

an indication of some kind of human pollution activities and in combination with high levels of nitrogen, it is usually an indication of sanitary pollution, animal waste by-products, or fertilizer run-off.

The *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory* dated May 13, 2005 indicates **Segment 0228, Lake Mackenzie** is meeting all its standards and criteria. With the limited number of data available, the Authority's assessment revealed some elevated total phosphorus levels, which could lead to a nutrient enrichment concern.

Lake Mackenzie

Reach V of the Red River Basin begins at the eastern edge of the Texas Panhandle in Hemphill, Wheeler, and Swisher Counties and extends westward to Amarillo for about 100 miles. The reach contains the North Fork of the Red River upstream to the headwaters of McClellan Creek, including the headwaters of the Salt Fork of the Red River, Elm Fork of the Red River, and the Washita River. The eastern edge of the City of Amarillo is located in **Reach V.** In addition, the towns of Panhandle, Clarendon, Wheeler, and White Deer are located in this reach.



The largest reservoir in the reach is Greenbelt Lake located in Donley County. Lake McClellan, a small lake, also in the reach, is underlain by the Ogallala Aquifer in the northern and western areas.

Segments contained in **Reach V** include:

0222 - Salt Fork of the Red River
0222A - Lelia Lake Creek
0223 - Greenbelt Lake
0224 - North Fork of the Red River
0299A - Sweetwater Creek

Reach V contains four wastewater outfalls, 17 solid waste disposal sites, of which five sites are active. There are14 permitted concentrated animal feeding operations, one superfund site, and four industrial hazardous waste sites. In addition, there are more than 3,100 groundwater wells located in this reach.

Farms and ranches predominate **Reach V** primarily raising cattle, while the farming consists of cotton, grain sorghum, wheat, corn, oats, barley, and alfalfa.

During the reference period from September 1, 2004 through August 31, 2005, the Authority conducted 12 monitoring events and collected approximately 348 parameters from three water quality monitoring stations. The TCEQ conducted six monitoring events and collected around 150 parameters from two water quality monitoring stations. **Figure 6** illustrates the monitoring coverage of **Reach V**, where each monitoring station is designated by a five digit numeric code.

Water quality conditions have improved in **Reach V**. The increase of precipitation has helped the region by providing pasture and watering for livestock. However, most of the concerns in this reach are still drought related.

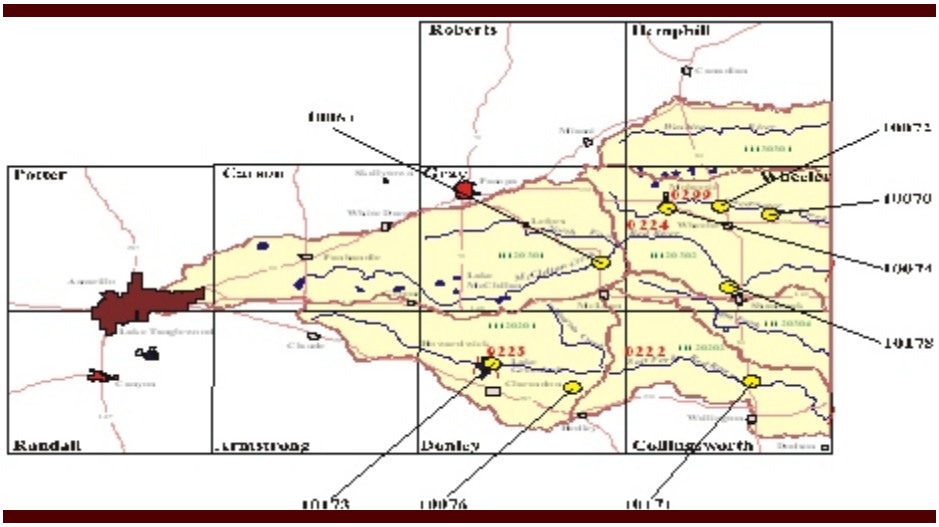


Figure 6

Segment 0222-The Salt Fork of the Red River, 0224 - Segment The North Fork of the Red River, Segment 0222A- Lelia Lake Creek, and **Segment 0223- Greenbelt Lake** are all listed on the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* as fully supporting their overall uses and criteria. The Authority's review of the data agrees with the assessment of these waterbodies.

Sweetwater Creek, Segment 0299A is listed on the *Draft 2004 Texas 303(d) List* and the *Draft 2004 Texas Water Quality Inventory, May 13, 2005* for not supporting its contact recreation use due to elevated bacterial levels. Although the source is not known, the elevated bacteria is possibly related to the numerous concentrated animal feeding operations in the watershed of the creek. Increased rainfall and run-off into the creek have likely increased the concentrations. More data needs to be collected to ascertain the nature of this problem.

PUBLIC PARTICIPATION AND OUTREACH

One component of the Clean Rivers Program is public participation. This enables the general public to broaden their awareness of water quality conditions, share knowledge and expertise of many, and cooperatively pursue avenues to rectify problems. The reflection of service with an emphasis on good science is fundamental to the Authority's purpose.

✯Steering Committee

Originally conceived as a grass-roots project, the Clean Rivers Program established a format for the citizens of Texas to participate in effective statewide watershed planning activities. Each Clean Rivers Program partner agencies developed a steering committee to set priorities within its own individual basin. These committees bring together diverse interests within each basin and watershed. Steering committee participants include representatives from the public, municipal, county, state, and federal government, industry, business, agriculture, environmental, education, civic organizations, and others.

As one of the most successful components of the Clean Rivers Program within the Red River Basin, the Steering Committee has guided this program over the years. The committee provides valuable assistance and guidance concerning water quality issues.

The Steering Committee and Basin Advisory Committee are one and the same. When originally formed, the Steering Committee was created to meet together when it may not have been possible for the entire Basin Advisory Committee to meet. However, through the years, the two committees have evolved into one, which serves its purpose very well.

Basin Advisory Committee Meetings are held at least once per year and are set up to be open, friendly, casual, and informative. They are designed to provide in-depth technical information regarding project work plans, monitoring schedules, reports, and any other relevant topics. Committee members are encouraged to ask questions and present their ideas at the meetings, as well as throughout the year.

✯Volunteer Environmental Monitoring

The Texas Rivers Project, in its 15th year, provides an opportunity for area students from junior high through high school to actively collect and analyze samples from their own unique monitoring sites. More than 12 schools have participated in the program since it was initiated. However, due to budget restrictions and time restraints, educators are not able to participate in the Texas Rivers Project as they have done in the past. The Authority is currently exploring ways to revitalize the program.

⚹Earth Day

The Authority is proud to be associated with local Earth Day celebrations. Earth Day is celebrated in cooperation with River Bend Nature Works, an environmental educational center located in Wichita Falls that provides hands-on environmental programs to children and adults. Last year's event was held in April, with more than 750 school children participating. The Authority's Environmental Services Division staff provided presentations on water quality and conservation to the students. Teachers were also provided with environmental educational materials for their students.

⚹Education

Authority personnel also provide presentations to various organizations, clubs, and civic groups to spark interest and awareness in local natural resource issues. Additionally, the Authority provides all types of information and articles that appear regularly in newspapers throughout the basin.

Another program sponsored by the Authority is the distribution of educational materials. The *Major Rivers* and *Think Earth* curricula are provided to all schools upon request. These two publications are favored by teachers and students alike. Last year over 110 boxes of water quality educational material was provided to schools in the Red and Canadian River Basins.

⚹Red River Authority of Texas Website

The Authority maintains a compelling commitment to provide up-to-date scientifically correct information on the website at www.rra.dst.tx.us. The website provides a virtual on-line encyclopedia of information and resources. The home page allows the user to locate information about the Authority and historically research the Red River Basin, and much more.

A popular feature on the Authority's website is the *Public Information Repository* which guides one to a wealth of information. Facts and data on almost any aspect of the Red River Basin are just a few clicks away. Other information available include: data inventories, digital mapping, general information, legislation, environmental sites, and historical weather data. The Authority also maintains an online publication library that includes reports and studies prepared by the Authority.

SUGGESTIONS FOR FUTURE WORK IN THE RED RIVER BASIN

As a Clean Rivers Program Partner, the Authority continues to monitor sites, analyze the data collected, determine trends, and assist in the development of Best Management Practices to maintain and/or improve the water quality in the Red River Basin.

The Clean Rivers Program has not received an increase in program fees since its beginning in 1991. With rising costs for

services and supplies, monetary restrictions have been implemented. This has forced program partner agencies to reduce sampling events and parameters collected. Since the number of monitoring sites and parameters needed to meet the Clean Rivers Program goals are far more than can actually be sampled, an increase of continuous monitoring stations should be implemented to provide a constant, reliable source of water quality data. In addition, it is the Authority's opinion that stream segments associated with the greatest risks of not attaining its water quality standards should receive the highest precedence.

As an agency of the state, and in compliance with its mission, the Authority provides financial assistance as much as possible to alleviate some of the budget shortfalls, and also contributes to the Clean Rivers Program by payment of fees assessed to fund TCEQ's water programs. The Authority supports itself through contractual agreements with governmental and non-governmental entities, limiting the additional funding required to adequately monitor the basin's many water resources. Nevertheless, the Authority will continue to work toward full attainment of the Clean Rivers Program goals.

The Authority receives its guidance from the TCEQ, but also listens and responds to the needs provided and directed by the Basin Advisory Committee.

BECOME INVOLVED

Active involvement is vital in the watershed management in the Red River Basin for the Clean Rivers Program. There are many ways to become involved in the planning of the basin's water quality and environmental health.

For information on becoming involved in the Basin Advisory Committee or other public outreach activities, please contact the Authority or refer to the Authority's website at www.rra.dst.tx.us.

The Red River Basin Highlights Report was Prepared with and Financed through Grants from the Texas Commission on Environmental Quality